STAT

Sanitized Copy Approved for Release 2011/07/12 : CIA-RDP80-00809A000700240091-3

STAT

SOVIET APPLICATION OF RADIOACTIVE ISOTOPES IN MEDICAL AND BIOLOGICAL RESEARCH

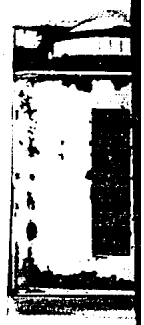
[Comment: This report presents the full text of an article published in Meditsinskiy Rabotnik, Vol 18, No 68, Moscow, 19 August 1955, on Soviet application of radioactive isotopes in medical and biological research, as presented in papers given by Soviet scientists at the Geneva conference on atomic energy.]

The papers that have been presented by Soviet scientists at the International Scientific and Technical Conference on the Peaceful Utilization of Atomic Energy which took place at Geneva reflect the achievements of science in the USSR. Great interest was elicited by a paper given by M. N. Fateyeva, Doctor of Medical Sciences, concerning USSR experience in the clinical and diagnostic application of some radioactive isotopes. Fateyeva indicated in her report that radioactive isotopes are being used at medical institutions of the Soviet Union to diagnose various diseases with an increased degree of precision. Radioactive iodine has been used during a number of years for the investigation of the functioning of the thyroid gland when various pathological conditions are present. This method makes it possible to acquire precise knowledge of the activity of the thyroid gland. The mean coefficients of the absorption of radioactive iodine by the thyroid gland were determined at various times after the introduction of this isotope. These measurements have been carried out both on healthy persons and patients suffering from hyperthyroidism or hypothyroidism.

The investigations that had been carried out made it possible to establish that changes in the functional state of the thyroid gland take place not only when a pathological condition of the gland itself is present, but also in connection with diseases of the cardiovascular system such as high blood pressure, defects of the heart, etc., and furthermore in connection with various diseases of endocrine glands. As a result of investigations carried out with the aid of radioactive iodine at foci of endemic goiter in the Urals, in the Chernovitsy Oblast, and in Khakassiya (in the Abakan region), it was possible to establish the characteristics of the functional condition of the thyroid gland in persons who live in regions where goiter is endemic and thus gain further knowledge pertaining to the clinical aspects of endemic goiter. In difficult cases another index was used in addition to that of the absorption of radioactive iodine by the thyroid gland, namely, the index measuring the elimination of radioactive iodine with the urine.

To investigate the dynamics of blood circulation, principally in persons suffering from cardiovascular diseases, the radioactive isotopes of sodium and phosphorus were used. The velocity of blood circulation was measured both in the greater and the pulmonary cycle. The local tissue blood-flow in patients suffering from hypertension and defects of the heart was measured, and the total volume of the blood circulating in the body in some diseases and in cases of cardiovascular disturbances were determined. All these investigations enabled physicians to acquire a deeper knowledge of the diseases involved and to apply more effective therapy. The results of the work outlined in this report have been applied widely at USSR medical institutions. They indicate the value and the promising character of the method of applying radioactive isotopes in the diagnosis of some human diseases.

STAT



Soviet scientists have also presented reports on the application of radioactive isotopes in biochemical research. Academician A. V. Palladin and G. Ye. Vladimirov in their report gave information on the most important results of investigations dealing with the biochemistry of the brain.

The method of tracer atoms furnished the possibility of studying the functional biochemistry of the brain with the observation of one of the most important requirements pertaining thereto, namely, that the processes of brain metabolism must be studied in the absence of traumas which affect the whole organism. It has been established that the functionally most complex divisions of the central nervous system are distinguished not only by an increased content of proteins, but also by a protein metabolism which is highest. Direct dependence has been established between the level of functional development and the intensity of the metabolism of phosphorus-containing compounds in various divisions of the brain. Particularly effective was the application of radioactive isotopes in establishing the typical characteristics of brain metabolism accompanying the basic physiological states of the central nervous system, i.e., those of excitation and inhibition.

The study of metabolism during excitation has shown that the application of radioactive isotopes makes it possible to determine the characteristics of metabolism which are typical for the state under investigation. For instance, investigation of the phospholipids of the cerebrum during excitation brought about by the administration of pervitin (A. Rybina) led to the finding that neither the total content of phospholipids nor the content of saturated or unsaturated phospholipids undergo any changes within 3 hours after introduction of the pervitin. One may conclude from this that the metabolism of phospholipids is not affected by excitation. However, application of radioactive phosphorus made it possible to establish that the introduction of phosphorus into both fractions of phospholipids takes place in a different manner after an excitation has been brought about by pervitin. For that reason one may conclude that the state of excitation is accompanied by definite changes in the phospholipid metabolism.

The data obtained in extensive and many-sided investigations carried out with the aid of radioactive isotopes at various scientific institutions of the USSR that have been presented in Rybina's report denote the beginning of a new stage in biochemical research in general and in the investigation of the biochemistry of the brain in particular.

Prof D. L. Ferdman presented new data dealing with the investigation of biochemical processes occurring in muscles during experimentally induced diseases. This investigator established that the intensity of the restoration of all proteins of the muscle tissue with the exception of collagen depends on the functional state of the muscles. When the functional state of the skeletal and heart muscles is one of weakness but there is no reduction in the total mass of muscle, the intensity of the restoration of proteins is lowered. In cases of distrophy of skeletal muscles brought about by a shortage of vitamin E, by an increased degree of functioning of the thyroid gland, or by severe atrophies of muscles accompanied by a reduction of their mass, the intensity of the restoration of proteins in the muscle fibrils was found to proceed at an increased rate. These investigations are of importance for the development of methods aimed at the restoration of the normal functioning of the muscular apparatus in various diseases.

A report by Prof V. N. Orekhovich, presented by A. M. Kuzin, contained information on original experimental research dealing with the synthesis of protein in isolated blood plasma, in chickens' eggs, and in connective tissue. These investigations were carried out with the use of amino-acids labeled with radioactive carbon.

Sanitized Copy Approved for Release 2011/07/12 : CIA-RDP80-00809A000700240091-3

STAT

Notwithstanding the large number of investigations dealing with protein metabolism that have been carried out, such important problems as the way in which synthesis takes place and the manner in which the proteins undergo transformations in the body have not been solved as yet. At present, there are differences of opinion in regard to the way in which the synthesis of proteins takes place and also in regard to the mechanism of their transformation in the body. Some investigators assume that in addition to the processes of the decomposition and synthesis of proteins in the organism there is also replacement of component parts of the protein molecules without thoroughgoing scission. In other words, the processes of inclusion and elimination of individual amino-acids proceed at different times and are independent of each other. Other investigators assert that inclusion of amino-acids into proteins takes place only during the process of the neo-formation of protein molecules.

In follows from the material presented in the report that, after the proteins of extracellular formations investigated in the laboratory have been synthesized in the cells of the body, no replacement of amino-acids takes place in them.

At the meeting of the section of biology and medicine, reports by the Soviet scientists Prof N. M. Meysel' ("Concerning the Biological Action of Ionizing Radiation on Microorganisms") and Prof I. M. Pigalev ("Some Problems of Immunity Connected With the Action of Ionizing Radiation on the Organism") were discussed.

Investigation of the regularities underlying the action of ionizing radiation on microorganisms is of great importance for the clarification of the general nature of the radiobiological effect and for the effective utilization of radiation in practical work. The facts presented in Meysel's report refute the concept that the reaction of microorganisms to radiation reflects exclusively an effect on the chromosomes and genes. The views of those investigators who were of the opinion that radiation accelerates the course of life and thus shortens it by expediting the transition to aging and death has also not been confirmed. The modifications of microorganisms which take place under the effect of radiation do not have anything in common with physiological aging. They undoubtedly represent a diseased condition which arises as a result of the affliction of a number of vitally important parts of the cell.

Investigation of the structural, cytochemical, and cytophysiological modifications which take place in microbial cells after irradiation indicates that there are no structures or substrates in living matter which are not sensitive to radiation and are not afflicted by it to some degree.

In living monocellular organisms, there are more sensitive and less sensitive structures and biochemical systems as far as the effect of radiation on them is concerned. The more complex high-molecular systems proved to be relatively more sensitive. The primary effect produced by radiation is not exerted on the nuclear structures of the cell alone, but also on different biological structures and biochemical substrates such as proteins, phosphorus compounds, enzymatic systems, etc.

Parallel to the structural and biochemical modifications changes take place which affect the vital functions of the microorganisms. The most easily affected is the function of division. The function of growth is a little bit more stable. The functions of respiration and fermentation proved to be very resistant and stable.

STAT

Of major importance are the effects of even small doses of radiation on the structure and metabolism of the most immediate progeny of the irradiated bacterial cells. These data open genuine possibilities of accomplishing directed modifications in the metabolism of microorganisms not only by bringing about mutations but also by exerting a radiation effect on the total population of the bacteria which participate in the process of multiplication. In this manner the formation of various valuable products by these microorganisms can be augmented.

In the report by Professor Pigalev it was brought out that ionizing radiation exerts a great influence on the development of immunity and on the state of the mechanisms which protect against infection. In connection with this, new data were mentioned which are of pathogenetic and immunological importance. The regional character of changes in the bactericidal properties of the skin and the fact that there is a reduction in the bactericidal activity of the saliva were established. In experiments carried out by Prof N. N. Klemnarskaya on irradiated animals, the importance of the site of the introduction of the antigen in immunization against typhoid was demonstrated. It was found in a comparative evaluation of various methods of vaccination that, when the vaccine is introduced intraperitonially, there is formation of antibodies in the irradiated animal. On the other hand, no immunizing effect takes place when the vaccine is administered subcutaneously to such animals.

Investigations by A. F. Kosov established that in the immunization of irradiated animals against tuleremia the quantity of vaccine introduced in the primary immunization is very important. When quantities of vaccine twice as high as the commonly used doses are introduced, the immunizing effect is more pronounced and the immunological reactivity is preserved for a longer time. The facts established in Kosev's investigation are undoubtedly of practical importance.

Changes in immunity under the effect of incorporated radioactive substances have not been mentioned in the literature hitherto. Kosev has shown that under the action of polonium or radiothorium the interference with immunigenesis in general takes place in the same manner as under the effect of external irradiation with X-rays. This indicates that the mechanism of the effect is the same irrespective of the nature of the ionizing radiation. From the standpoint of pathogenesis, data obtained in experiments on the conditions pertaining to the combined action on the organism of radioactive substances and a toxin are of importance. Under the conditions mentioned, there is mutual interdependence of the process due to radiation and the process due to the effect of the toxin. One observes phenomena of competition expressed in the inhibition of one and reinforcement of the other process, i.e., an interdependence which proves the role of the nervous system in the changes that take place.

One should note that in the total complex of the changes to which various organs and systems are subjected in radiation sickness the disturbances of immunological reactions which have been mentioned above should be regarded as individual stages of a single process which is initiated by the primary reaction. The latter forms the cause of subsequent, secondary changes. The character and degree of the disturbances which take place are determined in many respects by the state of the nervous system.

- E N D -